Lesson 1

Woman surfer

What a Resource!

In this lesson, students follow a surfboard from the formation of its raw materials, through production, to its sale at a surf shop, to its first use in the California surf. Through this example students learn the three general steps in a manufacturing process: choosing materials in the design phase; extracting or harvesting raw goods from natural systems; and transporting raw goods from source to processor or manufacturer.

This lesson also introduces students to the role they will play in the remaining lessons of the unit and the culminating unit project. As the imaginary owner of a new toy company located in California, each student creates a design for his or her company's first toy and identifies its basic material components. In a journal, which acts as a cumulative record of learning throughout the unit, students track the new knowledge they gain in each lesson and apply it to the design and manufacture of their toys.

Background

Everything that surrounds people comes from natural systems. Air, water, living things, light, temperature, and the ground are all components of natural systems. Any material that can be extracted, har-

Learning Objective

Identify the natural origin of the materials used to make common objects.

Provide examples of the goods that are produced by natural systems that are used to make common objects used by humans.

vested, or collected from Earth and used for human activity is a natural resource. Natural resources can be economically valuable rocks or minerals, plants, such as trees and agricultural crops, animals, and water. Molecules and atoms provide the raw materials that through natural processes in natural systems become natural resources. These materials form the basis of every substance in the universe, including human bodies.

Humans have always turned natural resources into useful products through manufacturing. Over time, as technology has become more advanced and knowledge is increasingly shared, the scale of manufacturing process has changed. The sheer magnitude of the extraction and harvesting methods now employed, as well as the volume of raw materials required to keep up with manufacturing demands, occurs on a level never before been seen in recorded history.

Innovations in manufacturing technology have increased consumer choices—people can now choose from numerous varieties of the same vegetable; wear clothing made from hundreds of fabrics of different fibers; and light their homes with up to 50 different kinds of light bulbs. Deciding between the options at the local mall, supermarket, or home-improvement center brings about a sense of freedom and power. It is easy for people to lose sight of the origins of the products they choose as they contemplate a product's benefits, such as how they can make a person look and feel.

Seamstress working in sewing factory

Key Vocabulary

Extraction: The removal of a natural resource from its natural origin or the separation of a metal from ore.

Harvesting: The gathering, catching, or removing of natural resources, such as crops, fish, or timber.

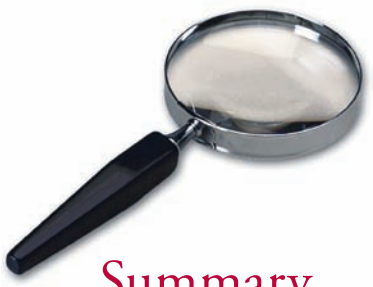
Manufacturing: The processing of goods or creation of products on a large scale.

Natural resources: Materials and material capacities, such as forests, water, and energy reserves, supplied by natural systems and used by humans.

Processing: Refining natural resources into raw materials, so that they can be consumed or used in manufacturing.

Raw materials: Natural resources that have not yet been processed or used to manufacture a product.

Toolbox



Summary of Activities

Students read about surfboard manufacturing and chart the steps through which natural resources become objects useful to people. They then begin to design toys for manufacture. Throughout the unit students gather addition information about the manufacturing process they can use to further develop their toys.

Instructional Support

See Unit Resources, page 28

Prerequisite Knowledge

Students should know about:

- different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and how to classify them as renewable or nonrenewable.

Students should be able to:

- define natural resources (especially rocks, minerals, petroleum, and forests) as materials people use that come from natural systems.

Advanced Preparation

Gather and prepare Activity Masters.

Gather and prepare Visual Aids:

- Prepare transparencies.

Materials Needed

Manufacturing and Design Journal:
- Provided separately

A-V equipment:
- Overhead projector or LCD projector, screen

Class supplies:
- Construction paper, graph or blank paper, lined paper, pencils, pens

Visual Aids

Transparencies:
- **Natural Resource Use Flowchart,** Visual Aid #1
- **Origins Chart**, Visual Aids #2–3
- **Assignment**, Visual Aid #4

Duration

Preparation Time
30 min.
Instructional Time
60 min.

Safety Notes

None

Activity Masters in the Supporting Materials (SM)

California Connections: A Surfboard Story

SM, Pages 7–11
One per student

Procedures

Step 1

Have students choose an object in the classroom or from their desks. Ask students, "What is it made of?" and "How was it made?" Distribute a piece of graph paper or blank paper to each student and have students make a quick sketch of the object they selected. Have them label each part of the object that appears to be made of a different material.

After 10 minutes have students share the materials they identified in their object. (*Metal, plastic, wood, cloth, ink, etc.*) Tell students that many of these materials consist of natural resources, meaning that the raw materials that go into them come from natural systems. Ask students, "Where do some of these natural resources come from?" (*The ground, a forest or tree, oil, the ocean, etc.*)

Step 2

Project the transparency of the **Natural Resource Use Flowchart** (Visual Aid #1). Read through the steps of the chart with the class, following the arrows. Ask students, "Can you think of an example for each step in the flowchart?" Tell students that they will read a story about the creation of a surfboard. The story describes how people gather natural resources from Earth and use them as components in a typical surfboard.

Step 3

Distribute copies of ***California Connections: A Surfboard Story*** (Lesson 1 Activity Master) and have students read it individually or ask volunteers to read aloud. Have them stop reading on page 3 at the heading named "**Creating Glass Threads for Fiberglass**." Have students refer to the **Natural Resource Use Flowchart** as they read.

After students have read, ask them to share their observations about surfboard manufacturing and resource use. Use the following questions to guide the discussion:

- "What resources were used in the surfboard?" (*Oil, silica sand, limestone, and soda ash*)
- "How were those resources extracted or harvested?" (*They were drilled or dug from the ground or collected from water.*)
- "How were they changed and put together to make the surfboard?" (*The oil is made into foam and resin; the silica sand is made into glass threads to create fiberglass.*)
- "How do you think the surfboard gets from the factory to the ocean?" (*Somebody bought it at a store and took it to the water to surf.*)

Step 4

Distribute **Manufacturing and Design Journal** (individual student's copies) to each student. Have each student write his or her name on the title page and then turn to the next page, where the **Natural Resource Use Flowchart** is reproduced. The chart includes some key vocabulary and definitions at the bottom. Read through each of the words and definitions with the students.

Step 5

On the fourth page of the **Manufacturing and Design Journal,** students will see a reproduction of the **Origins Chart** (Visual Aids #2–3). As students flip to the fourth page of the journal, project the transparency of the **Origins Chart**. Ask students to identify the raw materials and resources on the charts that were mentioned in ***California Connections: A Surfboard Story.*** Have the class read the information in the first and last columns of the **Origins Chart**, which identify the categories of natural resources and the methods of extraction and harvesting. Explain to students that this chart does not give information for natural resources or raw materials used in all manufactured products, but it covers some of the popular resources addressed in this unit.

Step 6

Tell students that they have an assignment to complete over the next few weeks. Have students turn to page 6 of their journals (Assignment) and read the introduction together as a class. Project the transparency of the **Assignment** (Visual Aid #4) and explain the tasks for the first day of this assignment: Choose between the two toy options listed, describe your toy idea, list its major parts, and use the **Origins Chart** on pages 4-5 to identify the raw materials or natural resources needed to make those major parts.
(*Note: Tell students their toy ideas do not need to be finalized at this stage and that they do not yet need to do the work on pages 8 and 9.*)

Step 7

Give students the remainder of the class period (and homework time, if necessary) to complete pages 6–7 (Assignment) in their **Manufacturing and Design Journals**. When students complete this stage, collect the journals for use in assessment.

Lesson Assessment

Description

In this lesson, students identify materials used to make common objects and learn that these materials originate in natural systems. On page 7 (Assignment) of the **Manufacturing and Design Journals,** students describe their toy ideas, list the major components of the toy, and identify sources of the raw goods and natural resources needed to make those components.

Scoring Rubric

Score	Performance
5	Student lists three components and two natural resources for each component.
4	Student lists three components and one or two natural resources for each component.
3	Student lists two components and two natural resources for each component.
2	Student lists only one component and two related natural resources, or: Student lists two components and only one natural resource for each component.
1	Student lists only one component and one related natural resource.

Suggested Scoring

Student work on page 7 assignment from the **Manufacturing and Design Journals**, will vary by toy. Their entries on the chart should reflect realistic components and source materials. Refer to the **Origins Chart** (Visual Aids #2–3) for guidance (*Note: This page also appears as pages 4–5 (Origins Chart) in the **Manufacturing and Design Journal**).*

The following rubric can be used for scoring the assignment on pages 6–7.

Answer Key and Sample Answers

Assignment

Congratulations! You are the new owner of a toy company that makes toys for young children. The first decision you will need to make in your new job is what new toy you want to add to your toy line. Your company can make one of the following kinds of toys:

- **Stuffed animal** or **action figure**
- **Sports equipment** (balls, rackets, clubs, bats, etc.)

Over the next few lessons, you will design a plan to produce your toy. Your plan will include all stages of manufacturing. These stages will include extracting or harvesting the natural resources and raw materials you need, getting the resources to the factory, and putting the toy together.

Follow these steps to get started:

1. Decide on the type of toy your company will make. Write the name and type of toy here:

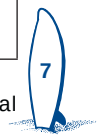
   Example: A dragon stuffed animal.

Manufacturing and Design Journal

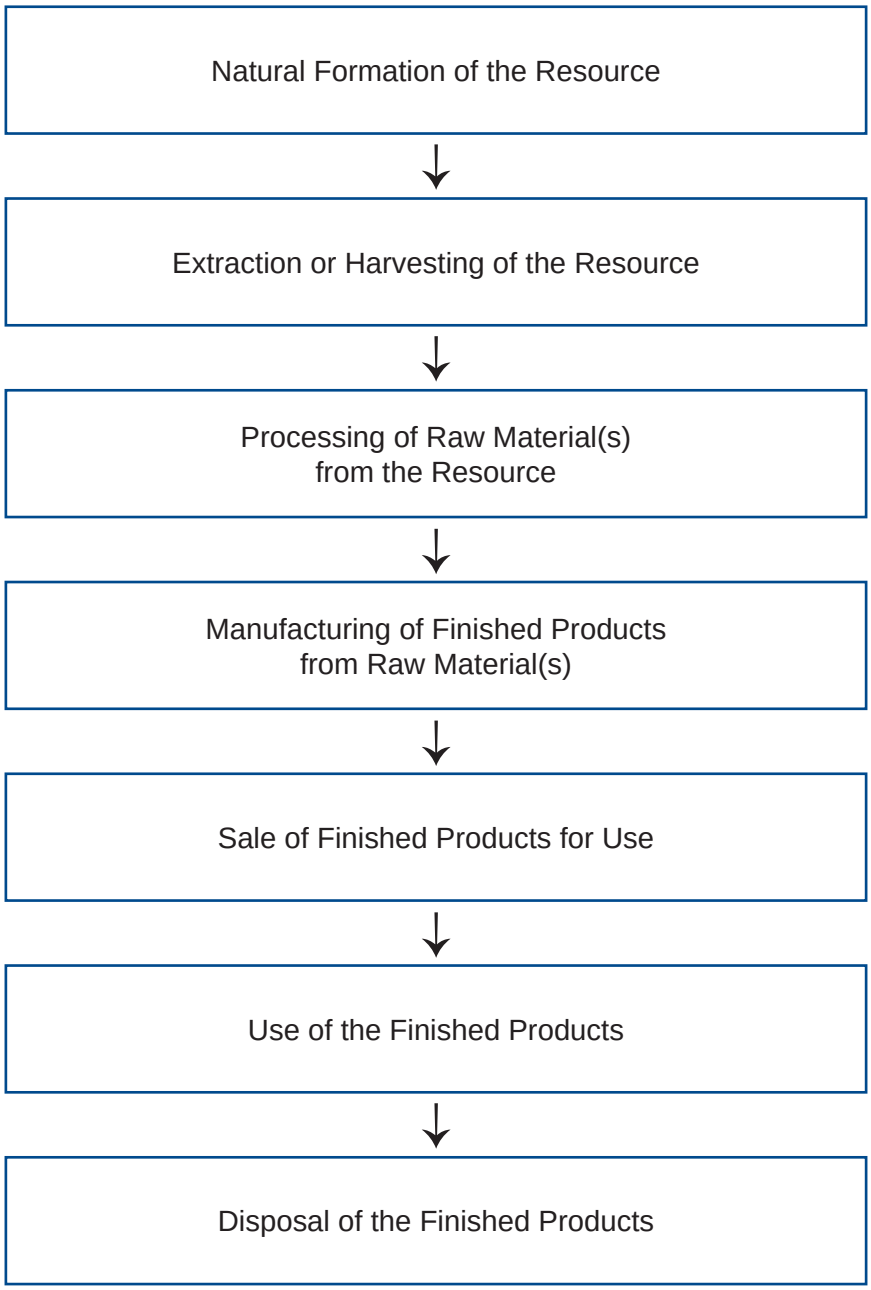
Assignment

2. List the parts of your toy in the first column, below. Make sure you include at least three parts. Using the Origins Chart on pages 4–5 as a guide, identify the raw materials and natural resources you might use to make each part of your toy. Think of at least two different materials for each part of your toy. You will be able to change your choices later.

Parts of toy	Natural resources/raw materials needed for parts
Stuffing	*Cotton (plants), foam (fossil fuels)*
Material on the outside (scales and fur)	*Shiny, hairy fabric (fossil fuels), with gold and silver threads (mineral ores)*
Eyes	*Glass (mineral ore) or plastic (fossil fuels, petroleum)*
Claws	*Metal (mineral ore) or plastic (fossil fuels, petroleum)*
Thread	*Cotton (plant) or synthetic thread (petroleum, fossil fuels)*
Glue	*Gelatin (animal bones)*



Natural Resource Use Flowchart



Key Vocabulary

Extraction: The removal of a natural resource from its natural origin.

Harvesting: The cutting and collection of natural resources such as crops or timber.

Manufacturing: The processing of goods or creation of products on a large scale.

Natural resources: Materials, such as forests, water, and energy reserves, supplied by nature and used by humans.

Processing: Refining natural resources into raw materials, so that they can be consumed or used in manufacturing.

Raw materials: Natural resources that have not yet been processed or used to manufacture a product.

Origins Chart

Raw material yielded	Natural resource category	Common uses in manufactured products	Method of extraction or harvesting
Bauxite	Mineral ore	Aluminum objects	Surface mining
Clay	Mineral ore	Dinnerware, pottery, tiles for floors and walls, buildings	Surface mining
Copper	Mineral ore	Electrical wires, batteries, cookware, plumbing pipes, coins	Surface mining
Cotton	Plant	Thread, fabric, batting, oil (cottonseed), cottonseed meal (used in livestock feed)	Collecting the seed pod from the plant
Gelatin	Animal	Glue	Rendering animal bones
Graphite	Mineral ore	Pencil lead (which contains graphite, not lead), batteries, lubricants and paint	Surface mining
Iron	Mineral ore	Frames for buildings, bridges, and other structures, tools, cookware, steel, batteries and magnets	Surface mining
Leather	Animal	Clothing, bags, fasteners	Skinning the hide from dead livestock

Origins Chart

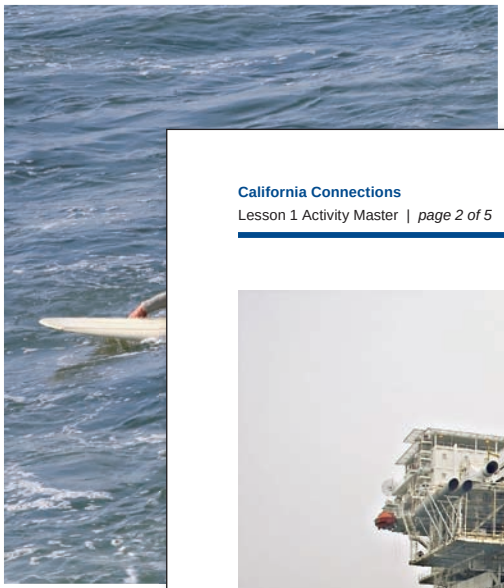
Raw material yielded	Natural resource category	Common uses in manufactured products	Method of extraction or harvesting
Limestone	Mineral ore	Fiberglass, building, roads, landscaping, and cement	Surface mining
Petroleum	Fossil fuel	Plastics, paints, synthetic fabrics (PVC), synthetic rubber, foams, thread,	Deep drilling
Resin (rosin)	Plant	Shellacs, cements, musical instrument strings	Collecting the sap from living trees
Rubber (natural)	Plant	Tires, gaskets, insulation, elastic fabrics and fasteners, foams, hoses	Collecting the sap from living trees
Silica/ Quartz	Mineral ore	Glass (and fiberglass), silicon for computer chips, jewelry, lenses, concrete, electronics, abrasives	Surface mining
Soda ash	Mineral ore	Glass (and fiberglass), and food sweetener	Underground mining
Tin	Mineral ore	Cans, containers, soldering material	Surface mining
Wood/ timber	Plants	Houses, floors, furniture, tools, paper	Cutting the stalk off the root (logging)

California Connections: A Surfboard Story

If you have walked along a California beach, you have probably seen surfers paddling out to catch a wave. As you watched their surfboards bob up and down in the water, did you ever wonder what makes those boards so tough, even though they are relatively lightweight? If you researched your question, you would learn that it takes only a few materials to make a surfboard.

A big part of surfboards is polyurethane, which comes from the natural resource oil. This oil was formed long ago in ancient oceans, perhaps right here in California. Marine animals that died millions of years ago drifted down to the ocean floor. Heavy layers of sand trapped the dead animals' bodies in airtight pockets. The heavy sand and water pressed down and over long periods created fields of sticky black oil.

Skip forward a few million years. Now in many areas of California, as well as off the coast, people extract this oil with drilling rigs. When workers first install a rig, pressure from the site forces the crude oil to the surface. Over time this pressure decreases. When the pressure drops too low to force the oil



Surfer paddling

Oil rig drilling near the Channel Islands

upward, workers add a rocking arm and continue to pump the oil from the ground.

The crude oil often contains materials that people cannot use. Workers remove these unwanted materials by putting the oil in settling tanks or separators. Then they ship the oil by pipeline or by truck to a refinery.

Manufacturers purchase some of the oil to make polyurethane, a chemical compound used in foams, elastics, and resins, and the key ingredient in most modern surfboards. The manufacturer usually ships the polyurethane by truck or train to a wholesaler, who unloads it and stores it for later sale.

From the wholesaler, truck drivers take the polyurethane to a surfboard manufacturer. In the surfboard factory, workers heat the polyurethane in a cement mold for 25 minutes. The heat triggers a chemical reaction and dense, white foam begins to froth. After it cools, builders use this foam to make the core of the surfboard.

The builders slice this white foam core (also called a blank) in two, lengthwise, like deli bread. A 1/8-inch piece of wood acts as the "meat" in this "surfboard sandwich" when builders glue it into place. The builders then clamp the surfboard shut to allow the glue to dry. The stringer prevents the surfboard from breaking in half.

Fiberglass Facts

As the surfboard hardens, you have time to look at the resources used to make the stringer. The process of making fiberglass uses three major ingredients: limestone, soda ash, and silica sand.

Like oil, limestone forms from the remains (shells

and bones) of ancient sea creatures. Wave action breaks up the shells and bones of marine animals and deposits the pieces on the ocean floor. Over millions of years, layers of shells, sand, and mud harden into limestone. People extract this abundant resource from many different places. Sometimes quarry workers take it from deposits on Earth's surface. In other places, miners extract limestone from underground deposits or caves.

Extracting soda ash is much different from limestone mining. In nature, soda ash is often invisible, since it dissolves in some lakes or accumulates in salt beds. People extract its white powder from these natural sources. However, scientists can also create soda ash in a lab.

The third key material in fiberglass is silica sand, which contains a lot of quartz. Over many years wind and water slowly grind quartz rocks into silica sand. People extract the silica sand from beaches, riverbeds, and lakes.

Mining companies use trucks or trains to ship the three minerals used to make fiberglass to wholesalers. The wholesalers sell the minerals and load them back onto trucks. The truckers deliver the minerals to the fiberglass manufacturer, where workers unload and store the minerals until they are needed.

Creating Glass Threads for Fiberglass

The manufacturer carefully weighs each raw material to get the exact quantities needed to make fiberglass. The workers mix the ingredients together and feed the batch into a furnace. To make glass fibers, the temperature must be very hot—approximately 2,500ºF (1,371ºC).

When the silica sand melts, it forms liquid glass. The molten glass goes into a machine with hundreds of small holes. The machine draws the glass through the holes, creating thin strands, or threads. These threads go into making many different fiberglass products. Workers load the products onto delivery trucks and ship them to manufacturers such as the surfboard maker.

Cutting fiberglass wrap

Finishing fiberglass

Meanwhile, Back at the Surfboard Sandwich

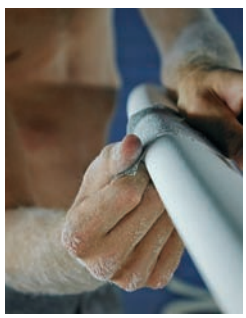
Now that the surfboard core and stringer are dry, a saber saw cuts around the drawing of the outline of the surfboard. Then a motorized planer levels out the final shape. (A planer is a machine that evens things out.)

A big sander goes to work next, repeatedly sanding to remove ridges from the surfboard blank. As a last step in shaping, builders mark the position of the surfboard's fin. Many builders add their own special designs, or signatures, to identify their work. Then they blow the finished blank clean with compressed air.

To make the surfboard colorful, builders spray on paint with an airbrush or spray gun. Then they dry the surfboard once more.

The key to making the surfboard last a long time comes in the next stage, called glassing. In glassing, builders layer fiberglass sheets and resin. Resin is a thick fluid produced by plants or, more commonly, manufactured from oil-based chemicals. Resin is strong and keeps the surfboard from chipping or cracking.

After glassing, builders coat the board with one more layer of resin to plug any flaws on the standing surface, called the deck. They flip the board over and position the fin. Next the builders wrap fiberglass tape around the fin and add resin to it. Finally they coat the surfboard's underside and fin with a filler layer of shellac which is made from trees. Later, when the entire surfboard is dry, the builders drill a small hole in the tail for a leg leash.



Final sanding

Woman surfing

A final round of sanding removes any excess resin. More dust flies as the compressed air puffs the board clean. The builders add decals and graphics before brushing a final coat of shiny gloss resin over the board in the last 15 minutes before it hardens.

In another 12 hours the surfboard receives its final rubbing, buffing, and polishing. Later, workers stack it with other finished surfboards, where they wait to be loaded onto trucks and delivered to surf shops around California and the country.

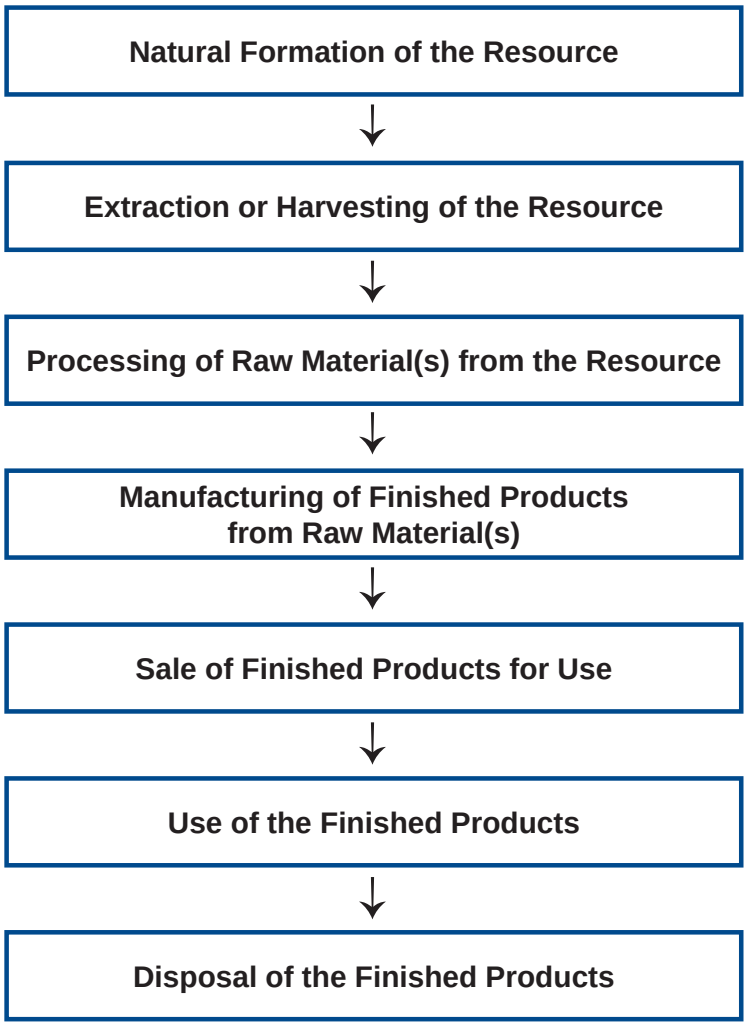
Surfboard Shopping

Two weeks later, a surfer walks into a surf shop. She tells the clerk she wants a sturdy surfboard, but one that is easy to carry. Thirty minutes later, she tucks her new surfboard under her arm and walks out of the shop to her buddies. They drive to the beach, unload their gear, and get ready to paddle out past the breakers.

Sitting on the shore with a friend, you look up a little while later to see this surfer carefully stand for the first time on her new surfboard. As she steadies herself, you turn to your friend and smile as you ask, "Hey, dude, do you know how surfboards are made?" When he shrugs, you say, "Well, it all began in an ocean a lot like this one millions of years ago…"

1 **Natural Resource Use Flowchart**
Visual Aid — Transparency

Natural Resources Use Flowchart



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Visual Aid — Transparency

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4 **Assignment**
Visual Aid — Transparency

Assignment

Congratulations! You are the new owner of a toy company that makes toys for young children. The first decision you will need to make in your new job is what new toy you want to add to your toy line. Your company can make **one** of the following kinds of toys:

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Follow these steps to get started:

1. Decide on the type of toy your company will make. Write the name and type of toy here:

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2. List the parts of your toy in the first column, below. Make sure you include at least three parts. Using the Origins Chart on Page 3 as a guide, identify the raw materials and natural resources you might use to make each part of your toy. Try to think of at least two possibilities for materials. You will be able to change your choices later.

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